

**A strategic systems perspective of organizational learning theory:  
*Models for a case study at the Jet Propulsion Laboratory***

OLIVIA ERNST NEECE

Jet Propulsion Laboratory  
California Institute of Technology  
4800 Oak Grove, Mail Stop 202-204, Pasadena, CA 91109-8099  
Tel: (818) 354-6234 Fax: (818) 393-4510  
email: [Olivia.H.Neece@jpl.nasa.gov](mailto:Olivia.H.Neece@jpl.nasa.gov)

The research described in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

# **A strategic systems perspective of organizational learning theory:**

## ***Models for a case study at the Jet Propulsion Laboratory***

### **Abstract:**

Organizational learning is an “umbrella” term that covers a variety of topics including; learning curves, productivity, organizational memory, organizational forgetting, knowledge transfer, knowledge sharing, knowledge assets, dynamic capabilities, knowledge management, and knowledge creation. This treatise will review some of these theories in concert with a model of how organizations learn. Several systemic theories of learning organizations and knowledge-based organizations are compared and contrasted with the current strategy and structure at the Jet Propulsion Laboratory (as presented in written organizational documents). The discussion illuminates the action-oriented nature of the model within an innovative organization. As a joint venture of NASA and California Institute of Technology, the Jet Propulsion Laboratory (JPL) represents a unique opportunity to study governance in a quasi governmental/academic organization, subject to the needs and objectives of an R & D facility and the cost/benefit constraints that occur in a profit driven corporate context. In conclusion, implications are evoked for further research at the Jet Propulsion Laboratory toward a generalizable theory of innovative environments and their organizational learning practices.

**KEYWORDS:** organizational learning, knowledge management, knowledge creation

Organizational learning theory traces its roots to psychological studies of individual learning curves. During experiments, a reduction in errors was noted as individuals gained experience in completing tasks (Ebbinghaus, 1964, original published 1885; Thorndike, 1898). Learning curves were found for communication networks and group performance, at the group level of analysis (Guetzkow & Simon, 1955). In order to determine why some firms are more productive than others, researchers have studied the measurement of learning curves in relation to organizational learning rates (Adler & Clark, 1991; Argote, Beckman, & Eppler, 1990; Hayes & Clark, 1986; Ingram & Baum, 1997; Lester & McCabe, 1993; Lieberman, 1984).

Organization memory in its earliest form was practiced by the railroads in terms of the dispersion of timetables, procedures, and rules. Later, scientific management, attempted to capture individual procedures to produce a standard work practice laid down in manuals, and a standardized reporting system (Taylor, 1911). These organization memory systems really include data and information. The earliest mention of “organization memory” relating to what we consider “knowledge” can be found in Herbert Simon’s (1957, originally written in 1945)

*Administrative Behavior*, 2<sup>nd</sup> Edition. Simon comments,

Since an organization is not an organism the only memory it possesses, in the proper sense of the term, is the collective memory of its participants. This is insufficient for organization purposes, first, because what is in one man’s mind is not necessarily available to other members of the organization, and, second, because when an individual leaves an organization the organization loses that part of its “memory.” Hence organizations, to a far greater extent than individuals, need artificial “memories.” (p. 166)

Senge (1990) discusses the evolution of interest in organization learning as traced by Weston (1993). Weston notes that theories of organization learning commenced with Don Michael’s book *On Learning to Plan—and Planning to Learn* (Michael, 1973). In actuality, early evidence of interest in organizational learning is found in Cyert and March’s (1963) seminal volume, *Behavioral Theory of the Firm*. The firm is described as an “adaptive system” with three

sub-theories of decision making; organizational goals, expectations and choice. In addition, they discuss four relational concepts; “(1) quasi resolution of conflict, (2) uncertainty avoidance, (3) problemistic search, and (4) organizational learning.” (p. 116) However, the “organizational learning” discussed by Cyert and March relates to a structural, decision making construct. The concern here is the adaptation of goals, attention rules and search rules and “organizational memory” in terms of precedents of structure and decision making rules.

This treatise explores the varied theories beyond the firm as an “adaptive organism”. These are broader knowledge related theories that are encompassed by the term “organizational learning.” These theories are examined in conjunction with the development of a process model for how organizations learn. Several theoretical models of organizational behavior from a systems perspective are discussed. The Senge (1990) model of five disciplines that enable organizational learning is reviewed and compared to the theories of Von Krogh, Ichijo and Nonaka (2000), Maciariello (2000), Ghoshal and Bartlett (1997) and others. A second model is proposed, linking the five disciplines to a proposed learning organization architecture, and discussing the model in relation to the purpose, structure and behavioral mechanisms in effect at the Jet Propulsion Laboratory (JPL). Implications for further research at JPL are discussed.

### **What is learning and in particular Organizational Learning?**

An ongoing debate between researchers concerns whether *learning* should be defined in terms of changes in knowledge or changes in behavior. At the individual level, learning has been defined: as changes in individual behavior (Hilgard & Bower, 1975), changes in "behavior potentiality" as a result of prior experience (Houston, 1986) and as a change in either behavior or knowledge brought about by practice or experience (Wingfield, 1979). At the organizational level, learning has been defined both as changes in knowledge (Duncan & Weiss, 1979; Fiol &

Lyles, 1985) and in terms of a “range of potential behaviors.” (Huber, 1991) The definition of organizational learning adopted here is inclusive of both the knowledge and the behavioral aspects of learning. Organizational learning, in this broader context, is inclusive of a large number of concepts (Huber, 1991). According to Argote (1999: 13),

Agreement has not emerged about exactly what is meant by the concept of organizational learning. In my view, the concept of organizational learning is likely to remain an 'umbrella' concept for many related concepts.

Some theorists have limited the definition of organizational learning to learning that enhances organizational effectiveness (Argyris & Schon, 1978; Fiol & Lyles, 1985). The author agrees with Huber (1991) that a broader definition of learning should be retained.

It seems important to highlight that learning need not be conscious or intentional, as is apparent in discussions of operant conditioning in humans and other animals (Bower & Hilgard, 1981) and in case studies of organizational learning. (March & Olsen, 1979: 89)

Further, it is apparent that learning evolves through a variety of channels, both internal and external to the organization.

The term “organizational learning” has been used to discuss a multitude of theories at the organizational level of analysis and the group level of analysis. These theories include; organizational memory and organizational forgetting (Anand, Manz, & Glick, 1998; Argote, 1999; Moorman & Miner, 1998; Tuomi, 1999; Walsh & Ungson, 1991), knowledge transfer, and knowledge sharing (Argote & Ingram, 2000; Bresman, Birkinshaw, & Nobel, 1999; Darr & Kurtzberg, 2000; Gilbert & Cordey-Hayes, 1996; Grant, 1996; Majchrzak, Rice, Malhotra, King, & Ba, 2000b; Szulanski, 2000; Zaltman, Duncan, & Holbek, 1973). Additional theoretical concepts that are related to this line of inquiry include; knowledge management (Adler, 1988; Alavi & Leidner, 1998; Davenport & Prusak, 1998; Hedlund, 1994; Sanchez & Mahoney, 1996), knowledge reuse (Hansen, Nohria, & Tierney, 1999; Markus, 2000) and knowledge creation (Alavi & Leidner, 1999; Davenport & Prusak, 1998; Grant, 1996; Hedlund, 1994; Kuwada,

1998; Matusik & Hill, 1998; Nonaka, 1994; Nonaka & Takeuchi, 1995; Von Krogh, Ichijo, & Nonaka, 2000). Another important theory is the knowledge worker (Bartlett & Ghoshal, 1995; Drucker, 1979; Drucker, 1999; Miller, 1977), who is charged with acquiring, sharing, managing and reusing knowledge. We should also include productivity (Drucker, 1991; Gray & Jurison, 1995; Gregerman, 1981; Hayes & Clark, 1985; Heskett, Sasser, & Schlesinger, 1997; Iansiti & West, 1997; Jurison, 1995; Maciariello, 2000; Pfeffer, 1994; Porter, 1996), which is often based upon how organizations utilize knowledge.

Due to the breadth and depth of research studies, theoretical treatises, and popular press coverage, continuing from 1963 to the present, we may assume that the learning organization has passed beyond the stage of a 'management fad' to a basic theory. Organizational learning has strategic implications for value creation so critical for organizations in today's high-speed economy.

### **Organizational Learning Taxonomy: Constructs, Sub-constructs and processes**

Organizing the literatures under the organizational learning "umbrella" assists in assessing their impact on various organizational activities and processes. Huber (1991), in his seminal work on the literatures of organizational learning discusses four main constructs: (I) **knowledge acquisition**, (II) **information distribution**, (III) **information interpretation**, and (IV) **organizational memory**. The following is a discussion of the organizational learning literature within the context of Huber's taxonomy (Huber, 1991). The author has augmented this taxonomy by adding a fifth construct, (V) **knowledge creation and innovation**. It is important to keep in mind that these categories are merely representational and that much of the literature can be listed in more than one category. For that matter, much of the organizational learning literature is, by its very nature, multi-disciplinary. Thus, the subject of organizational learning,

knowledge and innovation appear in diverse literature sources such as strategy, organizational behavior, psychology, sociology, information systems, and engineering management.

### ***I. Knowledge Acquisition***

The **knowledge acquisition** construct is organized around five sub-constructs. The first sub-construct is *congenital learning* includes institutionalized knowledge based on societal expectations (Meyer & Rowan, 1977) and knowledge inherited from its founders (Schein, 1985; Stinchcombe, 1965). The second sub-construct is *experiential learning*, including five sub-processes.

- 1) *Organizational experiments* both planned (Staw, 1977; Wildavsky, 1972) and in formal analyses of “natural” experiments (Huber, Ullman, & Leifer, 1979), assist organizations in determining the results of group processes
- 2) *Organizational self-appraisal* including action research where data about concerns and problems is collected and shared with organizational members has been found to assist change (Argyris, 1983; Lewin, 1947).
- 3) *Experimenting organizations*, the process of an organization frequently, and sometimes continuously, changing structures, processes, domains, and even goals (Hedberg, Nystrom, & Starbuck, 1976; Starbuck, 1984), encouraging organizational flexibility and survival in unpredictable environments (Hedberg, Nystrom, & Starbuck, 1977). Levitt and March (1988) disagree, and note that this behavior may likely to lead to “random drift”, and not organizational improvement (Lounamaa & March, 1987). Such constant change has been noted at Nortel Networks (Neece, 2000), however a longitudinal study is needed to discover the long-term implications of this strategy.

- 4) *Unintentional or unsystematic learning* (March & Olsen, 1979) where group learning is often found to be haphazard and multi-faceted (Cangelosi & Dill, 1965).
- 5) *Experience-based learning* including *learning curves*, *learning before doing* and *learning by doing*. As mentioned previously, Ebbinghaus (1885) found a reduction in errors was noted as individuals gained experience in completing tasks. Learning curves have also been used to measure communication networks and group performance (Guetzkow & Simon, 1955). Further, as groups gained experience, group errors were found to decrease at a decreasing rate (Leavitt, 1967). Experience curves have also been utilized to measure outcomes at the organization level of analysis. For example, quality, as measured by complaints or defects per unit (Argote & McGrath, 1993) and service timeliness, as measured by late delivery of products per unit (Argote & Darr, in press). It is important to separate learning effects from the productivity gains of other factors, such as economies of scale (Argote, 1999; Rapping, 1965).

A study of *learning before doing* and *learning by doing* by Pisano (1994) found that learning before doing (planning) was best in firms in fields with a well understood knowledge base. Learning by doing (practice, experimental approach) is best in an organization where the underlying knowledge base is not as well known (Eisenhardt & Tabrizi, 1995; Pisano, 1994; von Hippel & Tyre, 1995).

A third sub-construct, *vicarious learning*, includes “corporate intelligence”, the study of competitor’s strategies (Fuld, 1988; Porter, 1980), and diffusion theory or learning through imitation and knowledge transfer (Abrahamson & Rosenkopf, 1997; Attewell, 1992; Leonard-Barton, 1990; Rogers, 1983; Teece, 1984). The fourth sub-construct is *grafting*, acquiring the



knowledge through hiring or through mergers and acquisitions (Ellsworth, 1999; Lyles, 1988).

Matusik and Hill, (1998: 685) note,

The relationship between organizational knowledge and competitive advantage is moderated by the firm's ability to integrate and apply knowledge... Because grafting knowledge from the outside environment does not take place automatically, a firm needs mechanisms to bring public knowledge in, to transmit this knowledge within the firm, and to fuse the new knowledge with existing stocks of knowledge.

Another method of grafting is the use of outsourcing. It is the author's viewpoint that while contingent workers can bring public knowledge in, they can also disseminate valuable private knowledge into the external environment accelerating the decay of competitive advantage. The use of contingent workers can drive down costs in a cost competitive environment, but can bleed critical knowledge from the firm and can cripple the firm due to the organization's failure to build its critical competencies and stocks of knowledge.

The fifth construct of knowledge acquisition is *searching & noticing*. These processes include:

1. *Scanning* is the broad sensing of the organization's external environment for non-routine cues to relevant changes (Daft & Lengel, 1986). In addition, boundary spanning individuals may provide relevant scanning information (Davenport & Prusak, 1998).
2. *Focused search* involves a deep search into both internal and external sources, focused on the narrow needs of the particular problem (Cyert & March, 1963, 1992). Search prompting signals must be from multiple sources and insistent in order to gain attention (Ansoff, 1975), and it must be apparent that the present alternatives do not satisfy the goals (Feldman & Kanter, 1965).
3. *Performance monitoring* pertains to searching the organization for knowledge and cues as to specific learning situations and behavioral conditions (Mintzberg, 1975). Several researchers

have analyzed when and how organizations use or do not use feedback to improve their performance (Staw & Ross, 1987; Wildavsky, 1972)

4. *Noticing* refers to the unintended acquisition of information about the internal organization or external environment (Starbuck & Milliken, 1988).

### ***Construct II: Information Distribution***

The second construct is **information distribution**, the dissemination of knowledge and information throughout the organization. According to Huber (1991: 100), "...organizations often do not know what they know." Huber (1982) and Huber and Daft (1987) studied factors relating to the probability of routing of information from the transferor to the receiver; relevance of the information, power and status, costs, workload, previous relationships, rewards or penalties. The probability of delay in the routing of the information to the receiver is related to the workload of the transferor, the number of sequential links to the receiver and the timeliness of the information. The probability and extent of information distortion is related to the transferor's belief that distorting the information will be in their self-interest and the belief that distortion will not cause the transferor to suffer a penalty. Further, the discretion in the information format, difference between the actual information and the information desired or expected by the receiver, the work overload of the transferor, number of sequential links to receiver are also factors (Huber, 1982; Huber & Daft, 1987).

Another element of distribution, not included in Huber's taxonomy is knowledge management. Huber, instead includes this category of literature under "organizational memory".

### ***Construct III: Information Interpretation***

The third construct is **information interpretation**, defined by Daft and Weick as "the process through which information is given meaning," (1984: 294) as well as "the process of

translating events and developing shared understandings and conceptual schemes.” [Daft, 1984 #670: 286] However, a variety of interpretations may lead to additional learning opportunities (Huber, 1991). This interpretation of new information is affected by three subconstructs,

1. *cognitive maps and framing*, are the beliefs, mental models or frame of reference possessed by the individual, the group and the organization. From Roger Clarke's (1996) theory of language use, we know that veridicality of communication is more likely when both parties to the communication have a "common ground", defined as the knowledge, beliefs, and suppositions that both parties believe they share about the joint activity. Common ground evolves as presuppositions are created and destroyed, through interactions that include assertions, promises, questions, apologies, requests, declarations, and responses (Clark, 1996). Thus, common ground divides into three parts: initial common ground, an understanding of the current state of the joint activity, and an understanding of the events that participants presuppose have occurred that have led to the current state (Majchrzak, Neece, & Cooper, 2000a). Interpretations of information are dependent upon the way individuals diverge and converge in relation to the mental models of the group (Ireland, Hitt, Bettis, & DePorras, 1987; Walker, 1985). How information is framed affects its shared meanings (Tversky & Kahneman, 1985).
2. *media richness* is the extent to which common ground is established during knowledge transfer (Clark, 1996; Clark & Brennan, 1993). Olson and Olson (1998) found that collaborative technologies that support conversation, work objects being linked to conversations, and the creation of shared objectives were more likely to lead to common ground. Research supports the theory that timely feedback will assist in the process (Daft & Huber, 1987; Olson & Olson, 1998). Some theorists argue that face to face interaction is

superior for developing understanding (Clark, 1996; Olson & Olson, 1998), and that face to face interactions should be increased (Anand et al., 1998; Bresman et al., 1999). Others believe that it is necessary for groups share tacit knowledge prior to using other media (Davenport & Prusak, 1998; Olivera & Argote, 2000). Several research studies have found that face-to-face interactions actually distract the participants (Short, Williams, & Christie, 1976), and may lead to less effective outcomes (Culnan & Markus, 1987). Regardless of this debate concerning the preference for face-to-face communication, the author concurs with Duarte and Snyder (1999),

People who lead and work in virtual teams need to have special skills, including an understanding of human dynamics, knowledge of how to manage across functional areas and national cultures, and the ability to use communication technologies as their primary means of communicating and collaborating.

It is appropriate to note that shared interpretation is not required for groups or organizations to agree upon action (Donnellon, Gray, & Bougon, 1986; Weick, 1979) and that discussion and debate will lead to decisions, preferably based upon consensus.

3. *information overload* is the proliferation of more data than can be processed by the individual or the organization. The interpretation of information across organizational units or within the same group would be less effective if the information to be processed exceeds the limits of the individual or the group's ability to process the information (Driver & Steufert, 1969; Meier, 1963). Certainly, one of the key problems facing managers and workers today is not lack of data -- but too much data and a lack of systems that transform data into decisions or strategic advantage (Jinag, 1995). When multiple people push information, important messages get lost in the noise and information overload develops. A "well architected Intranet" is amenable to easy recovery of information when needed. Sparing use of the most

critical push information will minimize information overload (Alavi & Leidner, 1999; Telleen, 1999).

In discussion of information overload, Simon (1973) argued that, in order to reduce information overload, organizations should be designed with a minimized need for information distribution among organizational units. This "design for informational autonomy" is rejected by most theorists today, as this reduction in information sharing and transfer across units and would inhibit organizational learning (Huber, 1991; Sitkin, 1992). In fact, this type of design has been discredited since it leads to "information hoarding" (Argote, 1999; Davenport & Prusak, 1998) and "organizational silos" (Bower & Hout, 1988; Day, 1994; Drucker, 1988).

4. *Unlearning (or) organizational forgetting* is "a process through which learners discard knowledge." Hedberg (1981) stresses the discarding of "obsolete and misleading knowledge" (p. 18), implying that unlearning is functional and intentional. Use of the word "unlearning" implies a decrease in the range of potential behaviors or total information. Huber (1991) is concerned with the void that is created by the "unlearning" and the subsequent search for new knowledge in the vicinity of that which was unlearned (Cyert & March, 1963, 1992), or if the unlearning is aversive, in another area. Unlearning may open the way for new learning to take place (Huber, 1991). This is analogous to the notion that for organizational change to take place, an "unfreezing" occurs (Lewin, 1947; Lewin, 1951; Schein, 1985).

Argote discusses another, more negative aspect of "organizational forgetting" or "knowledge depreciation".

“...if there is forgetting, forecasts of future production based on the classic learning curve will overestimate future production. Failure to achieve expected levels of productivity can lead to large problems for organizations.”

Problems include; late deliveries, dissatisfied customers, financial penalties, and, in extreme cases, even organizational failure. One reason for knowledge depreciation is the loss of records, such as the Steinway blueprints for a discontinued piano (Lenehan, 1982, August). Another reason may be the inability to access archived records such as certain NASA data on an early mission that has been archived on obsolete electronic media. Similarly, where the media has decayed over time such as the information stored before 1979 by Landsat, an earth surveillance program (Marshal, 1989, June 6). Further, if information has not been documented through retrospective histories, lessons learned, or detailed recording of project specifications, activities and results, the details will soon be forgotten (Markus, Majchrzak, & Gasser, 2000). The greatest problem is employee turnover (Argote, 1999) through attrition, downsizing, retirement and loss. Depreciation arises not only through the loss of knowledge generators and integrators, but also the attrition of “gatekeepers” (Allen, 1977) who occupy key positions as a bridge in social networks (Burt, 1992; Krackhardt & Hanson, 1993).

#### ***Construct IV: Organizational Memory***

Variables that influence the successfulness of organizational memory are the firm’s knowledge architecture planning as well as various human factors. Huber (1991) comments,

...the ongoing effectiveness of organizational memory includes; (1) membership attrition, (2) information distribution and organizational interpretation of information, (3) the norms and methods for storing information, and (4) the methods for locating and retrieving stored information. (p.105)

Membership attrition has the most deleterious effect upon organizational memory. The literature on this subject is extremely broad and deep and we cannot cover it in the space allotted

here. The depreciation of knowledge has been briefly discussed during the consideration of the literature on organizational forgetting, and discussion of the importance of employee retention will be covered under the “knowledge creation and innovation” construct. In addition, several human resource centered strategic theories will be examined.

Much of organizational knowledge about the methodology, operations, or processes of an organization are “stored” in the form of routines, standard operating procedures and “scripts” (Argote, 1999; Gersick & Hackman, 1990; Mintzberg, 1975; Nelson & Winter, 1982; Winter, 1995). However, the knowledge-based theory of the firm suggests that a more secure and integrated method of storing and retrieving data, information and knowledge must be addressed. Storing and retrieving information includes both documentation of these routines, as well as storage and retrieval system for both explicit and some types of tacit knowledge. Many organizations are developing these integrated systems known as Knowledge Management Systems (KMS). Alavi (1999) defines knowledge management,

“Knowledge management, then, refers to a systemic and organizationally specified process for acquiring, organizing and communicating both tacit and explicit knowledge of employees so that other employees may make use of it to be more effective and productive in their work.” (p. 4)

He continues to define knowledge management systems (KMS) as

information systems designed specifically to facilitate codification, collection, integration, and dissemination of organizational knowledge.” (p. 4)

A key driver for KMS is integrative technology architecture with a variety of technological tools.

A typical knowledge management system involves a data (or knowledge) base, a cataloguing system, version control, document access control, a user-friendly search and navigation capability, and a variety of advanced features for communication and messaging such as email notification or commenting (Alavi & Leidner, 1999; Davenport, Jarvenpaa, & Beers, 1996).

“The need for seamless integration of the various tools in these three areas may lead to the

dominance of the Internet or internet-based KMS architectures.” (Alavi & Leidner, 1999, p. 18)

Because knowledge management systems involve the cataloguing of knowledge for later reuse, most knowledge management systems today have been developed to enhance the efficiency of a work process. As such, documents are captured and catalogued to support likely known future reuses, such as consultant services or administrative templates (Davenport et al., 1996; Majchrzak et al., 2000a).

***Construct V: Knowledge Creation and Knowledge Management:***

Knowledge creation models have been concerned with how tacit and explicit knowledge from individuals, groups, and entire organizational entity are combined to generate process, product and technological innovation (Kogut & Zander, 1992). Kuwada (1998) (Kuwada, 1998) describes the process of strategic learning as an interorganizational ecological process, integrating various levels of learning in organizations and including processes of both strategic knowledge creation and strategic knowledge distillation.

Underlying this model has been the debate concerning the sharp or blurred distinction between tacit and explicit components of knowledge. Nonaka and Takeuchi (1995) and Spender (1996) separate the tacit and explicit components of knowledge, as well as the individual vs. collective knowledge, yielding four “Weberian ideal types” of knowledge where every firm has a mix of all types:

- 1) conscious (explicit knowledge held by the individual)
- 2) objectified (explicit knowledge held by the organization)
- 3) automatic (preconscious individual knowledge)
- 4) collective (highly context-dependent knowledge which is manifested in the practice of an organization). (p. 51)

Using these distinctions, a view of knowledge transfer has been promoted that involves transforming tacit to explicit knowledge. (Hedlund, 1994; Kogut & Zander, 1992; Sherman &



Lacey, 1999). For example, Nonaka & Takeuchi (1995) propose a four-stage knowledge creation (i.e., transfer) model:

- 1) Socialization, experiencing tacit knowledge through apprenticeship or training.
- 2) Externalization or articulation; linking tacit knowledge with explicit knowledge and articulating knowledge to other team members;
- 3) Combination of different explicit ideas in a process of standardization such as a manual or knowledge management base; and
- 4) Internalization; extracting tacit knowledge from the newly created knowledge base, putting new knowledge to use, developing new routines and internalizing the changes.

Formalized communication structures and teambuilding interventions that improve the ability of team members to transfer, capture, and make tacit knowledge explicit may be a source of sustained competitive advantage (Bresman et al., 1999; Sherman & Lacey, 1999).

In contrast to the model of knowledge transfer in which tacit knowledge must be made explicit, Polanyi (1966) favors a blurred distinction between tacit and explicit knowledge, noting that there is a tacit component to all knowledge (Kogut & Zander, 1992; Teece, 1981). Tacit knowledge is often held sub-consciously until it is used (Reed & deFillippi, 1990). Tsoukas (1996) asserts that articulated knowledge is based upon an unarticulated background including social practices that are internalized and cognitive in nature. In an organization, the culture, routines, stories and the "invisible assets" of the organization are common repositories for tacit knowledge (Harris, 1994; Itami, 1987; Nelson & Winter, 1982; Ouchi, 1980). Thus, the knowledge transfer process is one of sharing stories and interpretations (Brown & Duguid, 1998) rather than making knowledge codified and explicit.

From this perspective, the knowledge transfer process may occur through the ability of an organization to combine both tacit and explicit knowledge. In this concept, knowledge is recombined from both inward and outward sources (Kogut & Zander, 1992). Kogut and Zander

(1992) note a circular connection between exploitation (use of internal knowledge) and exploration (invention, outward search). They state,

...an important limitation to the capability of developing new skills is the opportunity (or potential) in the organizing principles and technologies for further exploitation. Eventually there are decreasing returns to a given technology or method of organizing and there, consequently, results an incentive to build new, but related skills.

Adopted here is the Polanyi position that tacit and explicit knowledge should not be differentiated in the knowledge transfer process, especially as it pertains to the innovation context. This suggests that a knowledge transfer process for innovation needs to consider both the tacit and explicit elements of the knowledge simultaneously.

As comprehensive as Huber's taxonomy is, missing are categories for more comprehensive theories of the firm from a systems or strategic perspective. It is important to examine these theories in order to grasp a view of the learning organization as a whole. Two additional literatures shed light on the complexity of the firm. These are the Resource-based and knowledge-based view and the learning organization from a systems perspective.

### **Resource-based view & Knowledge-based view of organizations**

As firms struggled to succeed against foreign competition and productivity rates slowed or declined in American firms in the late 1980s, interest turned to the competitive use of firm assets. According to (Argote, 1999), this interest may have driven the move toward a resource-based view of the firm (Barney, 1991; Henderson & Cockburn, 1994; Lippman & Rumelt, 1982; Nelson, 1991; Prahalad, 1990). The resource-based view, for many researchers, was further developed to include the knowledge-based view of the firm, the study of knowledge as a strategic asset (Dierickx & Cool, 1989; Grant, 1996; Spender, 1996; Teece, 1990; Teece, 1998; Winter, 1995).

Numerous firms have leveraged their use of the firm's knowledge assets (Due, 1995; Hayek, 1989; Teece, 1990; Winter, 1987). If an individual is capable of responding quickly to environmental contingencies that require external networks and social systems with a high degree of centrality in the network their capabilities may be referred to as "dynamic capabilities" (Coff, 1999; Teece, Pisano, & Shuen, 1997).

A few of the more prominent examples of firms that have had great success through their utilization and maximization of knowledge are; Nucor (Drucker, 1994; Maciariello, 2000; Nobles & Redpath, 1997), 3M (Brand, 1998; Ghoshal & Bartlett, 1997; Lipman-Blumen & Leavitt, 1999; Thompson, Hochwarter, & Mathys, 1997), McKinsey (Dvorak, Dean, & Singer, 1994; Foster, 1986; Ghoshal & Bartlett, 1997; Halloran, 1993; Hansen et al., 1999; McKinsey, 1998), Lincoln Electric (Drucker, 1994; Maciariello, 1997; Maciariello, 2000; Pfeffer, 1994), and British Petroleum (Davenport & Prusak, 1998; Prokesch, 1997).

It has been theorized that firms that effectively transfer knowledge, while preventing competitors from tapping into their knowledge resources, are more successful than those that do not effectively manage their knowledge resources (Lippman & Rumelt, 1982; Winter, 1995; Zander & Kogut, 1995).

The problem is more complex since "...mere possession of potentially valuable knowledge somewhere within the organization does not necessarily mean that other parts of the organization benefit from that knowledge (Szulanski, 2000)." Internal knowledge transfer is difficult and is not a fluid process. Rather, the knowledge transfer process is inherently "sticky" (Szulanski, 1994; von Hippel, 1994). Stickiness refers to the difficulty of transferring knowledge between or among individuals, organizations or groups. One reason for the stickiness is the notion of the distributed nature of knowledge. A firm faces the problem that knowledge is not

concentrated or integrated, cannot be known by a single mind, and is disbursed into small “bits of incomplete and contradictory knowledge which all the separate individuals possess (Hayek, 1945).” Further, a firm is faced with radical uncertainty such that a firm’s knowledge is inherently indeterminate. Individuals cannot know what they need to know in ex ante (Tsoukas, 1996).

In addition, the firm is embedded in a larger and continually changing environmental context (Granovetter, 1992; Spender, 1989). Thus, knowledge in the organization is constantly filtered through the activities of the firm and through the socialized role-expectations and experiences of the organization’s members. The firm has some control, to a greater or lesser extent, over the normative expectations of members within the context of their work environment. However, the firm has no control over past social experiences outside the firm’s boundaries (Tsoukas, 1996). The relationship between a member’s role as a part of the firm and their role as a part of other organizations may produce internal conflict (Barnard, 1938; Griffiths, 1996; Senge, 1990a; Senge, 1990b). Inevitably, there will be tension between role-based expectations, the disposition of members and the social interactions within and between groups of individuals. As individuals apply their unique experience and perspective to situations, creative solutions can develop if the expectation of management is that firms are involved in an emergent knowledge process (Markus et al., 2000; Senge, 1990a; Senge, 1990b)

### **A model of how organizations learn – the creation of knowledge assets**

Several approaches to learning in the organization and to learning of groups within the organization have taken a micro-view of the organization’s purpose, values, and goals as they relate to firm structure. The structure inevitable drives the organizational policies resulting in the behaviors of groups and individuals within the firm. Many of these approaches have been

presented in terms of strategic and human resource policies that lead to leveraging of learning and knowledge assets (Ghoshal & Bartlett, 1997; Heskett et al., 1997; Maciariello, 2000; Pfeffer, 1994; Senge, 1990a; Senge, 1990b). To understand these approaches, we must first examine the learning process. A model can be developed tracing the process of how groups learn, related to the previously described taxonomy of literature (Exhibit 1). This provides the basis of an action model, firmly grounded in the theoretical underpinnings of existing organizational learning literature.

We assume that knowledge exists in a variety of forms; in the minds of individuals (Nonaka, 1991; Nonaka & Takeuchi, 1995; Polanyi, 1966; Spender, 1996), and in databases, documents, electronic media and other repositories (Alavi & Leidner, 1999; Davenport & Prusak, 1998; Majchrzak, Neece & Cooper 2000a). Access to the knowledge is available either directly through electronic media, documents and databases, experience or viewing and analysis of the process first-hand. When the knowledge is held by other individuals within the firm or by individuals or in repositories of external firms (suppliers, customers, strategic alliances, academic sources, and personal relationships), the access must be through knowledge sharing or knowledge transfer. Transfer may be either voluntary, with or without assistance from another individual or non-voluntary through research or “corporate intelligence”. Once acquired the information is interpreted; the knowledge is assessed (for its relevance), reused (adopted or adapted) (Majchrzak, Neece & Cooper 2000a), utilized to create new knowledge, and then evaluated for efficacy, usability, and credibility.

It is during this process that thorough documentation of the process or project, (e.g. specifications, details, and analysis) should be shared and entered into the organizational documents and databases in order to disseminate the learning throughout the organization. This

entire process is iterative and may constantly move in both directions from distribution, acquisition and interpretation and back again, until a decision has been made or an acceptable solution has been found. However, the process of transfer, sharing, learning and documentation does not take place in a vacuum. People must be trained, encouraged and motivated to accept others ideas, share their own, and provide documentation for the firm's database and document repository.

Numerous theorists, researchers and authors have proposed models and theories to assist firms in providing the organizational culture that encourages these behaviors. Some theorists provide models and suggest explicit structural methods and procedures that will elicit the preferred behaviors (Maciariello, 2000; Pfeffer, 1994). Several theorists have provided generalizable models of these processes that are more theoretical (Ghoshal & Bartlett, 1997; Senge, 1990a; Von Krogh et al., 2000). Discussed here are these theories including their relationship to the espoused mission, values, goals, objectives, and cultural norms of the Jet Propulsion Laboratory (JPL). I then develop hypotheses in concert with the five disciplines for testing at the JPL within their project team structure. I propose comparison of the adherence to the five disciplines, within a historical two year period, and the team's knowledge creation as measured by new patents, knowledge reuse as measured by how many ideas have been developed reusing knowledge from within JPL or other NASA centers, and contribution to organizational learning as measured contributions to databases and documents shared within the organization

### **Theory and Hypotheses: A systems thinking perspective of organizational learning**

Senge (1990), in *The Fifth Discipline: The Art and Practice of the Learning Organization*, unites our thinking about the organization from a systems perspective. The theory

combines five theoretical disciplines intertwined with systems diagrams that assist in understanding and developing an action-oriented approach. These action “prototypes” are circular systems diagrams that assist firms in describing their problems and in finding concrete solutions. *The five disciplines* include; **systems thinking, personal mastery, mental models, shared vision and team learning** (Exhibit 2).

The first discipline presented is actually the “fifth discipline”, **systems thinking**. It is a conceptual framework and tools that assist in clarifying the interrelationships, processes and patterns in the organization. It is a discipline for seeing the "structures" that underlie complex situations, and for discerning high from low leverage. The framework enables distinguishing between detail complexity and dynamic complexity. Detail complexity includes many variables that can be understood by asking the right questions. Detail complexity is analogous to Badaracco's (1991) migratory knowledge. Dynamic complexity, on the other hand is found in situations where cause and effect are subtle and where effects over time are not obvious. According to Senge, conventional forecasting, planning, and analysis methods are not equipped to deal with dynamic complexity. Systems thinking assists in avoidance of symptomatic solutions and focuses on areas in the organization where the change process will be effective (Senge, 1990a).

Ghoshal and Bartlett (1997) present two systems perspectives of the firm. The first is a model of *Management Context and Individual Behavior* [Ghoshal, 1997 #1114, p. ---] This systems perspective stresses the development of a new context that produces the following changes; (1) from constraint to stretch, (2) from control to support, (3) from compliance to discipline, and (4) from contract to trust. The second model is a *Renewal Process Model* [Ghoshal, 1997 #1114, p. --] In this model, the Entrepreneurial Process includes creating new

opportunities, developing individuals, and creating stretch opportunities. The Integration Process revolves around setting norms and values, attracting and developing competencies, linking knowledge throughout the firm and between organizations, and encouraging support and trust. The Renewal Process Model begins with development of corporate purpose, challenging embedded assumptions and includes continuous improvement and tension between short-term and long-term goals (Ghoshal & Bartlett, 1997).

Von Krogh, Ichijo and Nonaka (2000) provide a systems perspective in *Knowledge Enabling and Creation: 5 x 5 grid* (Von Krogh et al., 2000, p. ---). The five enablers include: (1) Instill a Vision, (2) Manage Conversations, (3) Mobilize Knowledge Activists, (4) Create the Right Context, and (5) Globalize Local Knowledge. The five creation steps include: (1) Sharing tacit knowledge, (2) Creating Concepts, (3) Justifying Concepts, (4) Building a Prototype, and (5) Cross-leveling knowledge.

Pfeffer (1994) discusses sixteen elements of “*What effective firms do with people.*” ((Pfeffer, 1994, pp. 27-65) He asserts that effective firms pay attention to language that separates people. Society tends to have the “wrong heroes” who exemplify antithetical behaviors to those preferred in society. Society tends to have the “wrong theories” that view workers needs as averse to the needs of the organization, including agency theory and transaction cost economics. These theories are inconsistent with governance systems that rely upon trust. The quality movement emphasizes intrinsic motivation, fosters better language, and has a long-term perspective

Maciariello’s (2000) *Agile Management Model* includes a Formal Management System [Maciariello, 2000 #1118, p. ---] and an Informal Management System [Maciariello, 2000 #1118, p. ---] These integrated systems both center on a planning, resource allocation and



reporting process. Elements of both systems include infrastructure, management style and culture, rewards, and coordination and integration.

JPL has provided a linked group of documents that outline all of the missions, values, goals, objectives, norms, values, organizational charts, projects, processes and procedures for the organization. They link these to the missions, goals and objectives of NASA. The format is very formal and appears to be quite hierarchical (Stone & Dumas, 2000). A study is proposed, here, that would assess the overall purpose, structure, culture and behaviors of the Jet Propulsion Laboratory in conjunction with these three systems perspective theories. Such a study would uncover convergence and divergence between espoused theory and theory-in-use.

*Hypothesis 1: From a strategic systems view, the organization's propensity to link their purpose, systemic structures, cultural norms, and rewarded behaviors to the outcomes of knowledge creation, knowledge reuse and organizational learning will be positively related to the production of these outcomes.*

**Personal mastery** is Senge's discipline of continually clarifying and deepening our personal vision, focusing our energies, developing patience, and seeing reality objectively. Personal mastery goes beyond competence and skills, beyond spiritual growth. It means "living life from a creative as opposed to reactive viewpoint." (Senge, 1990a, p. 141) The creativity is sustained through creative tension.

The juxtaposition of vision (what we want) and a clear picture of current reality (where we are relative to what we want) generates what we call 'creative tension'; a force to bring them together, caused by the natural tendency of tension to seek resolution. The essence of personal mastery is learning how to generate and sustain creative tension in our lives." (p. 142) ...some fear that personal mastery will threaten the established order of a well-managed company. This is a valid fear. *To empower people in an unaligned organization can be counterproductive* ...This is why the discipline of personal mastery must always be seen as one among a set of disciplines of a learning organization. (p. 146)

Senge's (1990) personal mastery discipline is aligned with the spirit of Ghoshal and Bartlett's (1997) Entrepreneurial Process segment of The Renewal Process Model. Elements of this process include; frontline managers creating and pursuing new opportunities, middle

managers developing individuals and supporting their initiatives, and top-level managers establishing stretching opportunities and performance standards (Ghoshal & Bartlett, 1997). The “manage conversations” enabler and Step 1, sharing tacit knowledge, offered by Von Krogh et al (2000), encourage personal mastery. Similarly, autonomy, empowerment, participative teams, training programs, skill development and cross training are enablers of personal mastery (Heskett et al., 1997; Kaplan & Norton, 1996; Maciariello, 2000; Pfeffer, 1994).

At the Jet Propulsion Laboratory, education, training and intellectual stretching are recognized as high priorities. In addition to available funding for academic degrees, a large number of both free and departmentally funded programs, seminars, and classes are available. Employees are encouraged to seek creative career development opportunities. The human resources department, along with various functional groups, attempt to assist individuals in finding intellectually stimulating opportunities on lab, at one of the other NASA centers or at California Institute of Technology. In addition, the projects themselves are stimulating as scientists, engineers and technologists join together to innovate and develop new technologies that have “never been done before”. One scientist at JPL said, “We’re going to Mars...and I get to do this, that is motivation enough.”

*Hypothesis 2: An organizations encouragement of personal mastery, including education, training, skill development, cross-training and empowerment will be positively related to the occurrence of knowledge creation, knowledge reuse and organizational learning.*

Senge’s (1990) discipline, **mental models** are deeply ingrained assumptions, generalizations that influence how we understand the world and how we take action. It is critical that we surface these mental models and test them for veracity and compatibility with current reality. Through this process, individuals need to avoid defensive routines, habitual modes of thought that prevent us from accepting new ideas (Argyris, 1985).

De Kluyver (1999) discusses the four types of organizational resistance to change delineated by Strebel (1994); structural and organizational rigidities, closed mind-sets reflecting obsolete strategies, entrenched cultures, and counterproductive change momentum.

“Counterproductive change is the most difficult to remedy because it typically involves altering all – structures and systems may have to be rethought, mind-sets must be changed, and new behaviors and skills have to be learned.” (de Kluyver, 1999, p. 50)

Four skills are included in the mental models discipline (Senge, 1990a, p. 186):

- 1) Recognizing “leaps of abstraction” (noticing our jumps from observation to generalization).
- 2) Exposing the “left hand column” (articulating what we normally do not say).
- 3) Balancing inquiry and advocacy (skills for honest investigation).
- 4) Facing up to distinctions between espoused theories (what we say) and theories-in-use (the implied theory in what we do).

This openness is a common theme found in Ghoshal and Bartlett’s (1997) Renewal Process of “challenging embedded assumptions”, in Lincoln Electric’s participative teams, frequent information sessions and open door policy (Maciariello, 2000), and in the participation and empowerment found at NUMMI (Pfeffer, 1994). It is embedded in Von Krogh and colleague’s enabler of Managing Conversations and is driven by their Knowledge Activists (Von Krogh et al., 2000).

JPL’s espoused theory describes a culture that “Facilitate(s) cultural change through open, candid, two-way communication.” (p. 55) The following values are included (Stone & Dumas, 2000):

1. Openness: of our people and our processes. We use candid communication to ensure better results.
2. Integrity: of the individual and the institution. We value honesty and trust in the way we treat one another and in the way we meet our commitments.

3. Quality: of our products and our people. We carry out our mission with a commitment to excellence in both what we do and how we do it.
4. Innovation: in our processes and products. We value employee creativity in accomplishing tasks. (p. 4)

*Hypothesis 3: An organization's encouragement of openness to new ideas, balancing of inquiry with advocacy, encouragement of trust, and alignment of stated theories with theories in use will be positively related to the occurrence of knowledge creation, knowledge reuse and organizational learning.*

**Building shared vision** is Senge's (1990) discipline that requires the skills of unearthing shared "pictures of the future" that foster genuine commitment and enrollment rather than compliance. The organization encourages each individual to develop a personal vision and to combine this with the firm's vision during an ongoing visioning process. A vision should blend intrinsic and extrinsic values, it should involve communicating and asking for support. Visions should never be posed in the negative and should not proffer a comparison to the effectiveness or success of other organizations. A vision isn't something to be tacked up on the wall or printed in a manuscript and forgotten, it is a living part of the organization.

Mission, vision, and purpose are all corresponding themes that are central to most strategic organizational theories. Von Krogh, Ichijo and Nonaka (2000) stress a "knowledge vision" that may or may not be part of a mission statement. They suggest four different management approaches; "top-down visionaries, expert visionaries, distributed visionaries, and 360° visionaries." Ghoshal and Bartlett (1997) include this in the Renewal Process for top-level managers (top down or expert visionaries) this differs from Senge (1990) who believes that everyone must be involved in the vision process (360° visionaries with support from distributed visionaries). Shared visions are enabled through employee security, employee ownership, employee involvement, appropriate training, compensation that rewards processes that support

the vision, and a long term view of the organization (Heskett et al., 1997; Kaplan & Norton, 1996; Maciariello, 2000; Pfeffer, 1994).

The JPL Mission is a blending of the NASA Vision and the JPL Vision specifically tailored to that portion of the NASA Mission that is to be fulfilled by JPL. The NASA Vision is presented in the *JPL Implementation Plan*. "NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on earth. The JPL Mission (Stone & Dumas, 2000):

Expand the frontiers of space by conducting challenging robotic space missions for NASA. Explore our solar system. Expand our knowledge of the universe. Further our understanding of Earth from the perspective of space. Pave the way for human exploration. Apply our special capabilities to technical and scientific problems of national significance. (p. 4)

JPL has developed an Implementation Plan that combines the Values, Implementation Strategies and Change Goals with the specific plans that fulfill all of these plans. Each of the specific Goals (e.g. science, administrative, educational) is tied to a specific Objective and JPL project. Each of the NASA Performance Targets is tied to a specific JPL Objective. JPL has additional performance targets that it relates to objectives.

*Hypothesis 4: An organization's sharing of the development and continual renewal, with all employees, of a vision that is both intrinsic and extrinsic will be positively related to their employees' understanding of and commitment to that vision.*

Senge's discipline of **team learning** starts with dialogue, to suspend assumptions and enter into a genuine "thinking together." Individuals may be prevented from thinking together by the defensive routines that inhibit their acceptance of ideas that differ from their own. Managers may intimidate their subordinates thus surfacing defensive routines that include compliance and failure to surface dissenting views (Argyris, 1985).

Senge (1990) asserts, “There are two primary types of discourse, dialogue and discussion. Both are important to a team capable of continual generative learning, but their power lies in their synergy.” (p. 240) Senge refers to the work of the contemporary physicist, David Bohm,

Bohm points out that the word ‘discussion’ has the same root as percussion and concussion...It suggests something like a ‘Ping-Pong’ game...the purpose of the game is normally ‘to win’...to have one’s views accepted by the group.” (p. 240)

Senge contrasts this with dialogue, from the Greek word ‘dialogos’, or the free flow of ideas between or among individuals. The ground rules for team learning: Suspend assumptions, act as colleagues, and explore ideas in a spirit of inquiry balanced with advocacy.

Team learning can be found in the knowledge sharing, openness, stretch and trust found in the conceptual models of all of these theorists. It is clearly presented in the Management Context and Individual Behavior Model identified by Ghoshal and Bartlett (1997) where stretch, support, trust and disciplines are the contextual cornerstones eliciting the behaviors of initiative, execution, confidence, commitment, learning and collaboration.

Exploratory studies of team learning at the Jet Propulsion Laboratory have shown a culture of sharing, collaboration, and inquiry balanced with advocacy. Further studies would be useful to determine how the reward structure is tied to knowledge sharing and the knowledge management process. It is particularly interesting to find whether these structures translate into organization-wide norms.

*Hypothesis 5: A team’s cultural norms of; collaboration, dialogue in the form of openness to inquiry, advocacy in terms of openness to discussion and differences of opinion, and reward structure tied to knowledge sharing and contribution to knowledge management and organizational learning will be positively related to the occurrence of knowledge creation, knowledge reuse and organizational learning.*

## **Conclusion: Building the Learning Organization**

Adaptive learning is about coping, and often leads us to push on symptoms rather than sources of problems. Generative learning is about creating. Generative learning requires new ways of looking at the world, and requires seeing the systems which control events. Leading corporations, to become successful learning organizations, should focus on this more powerful learning. Developed here is a model of *“Building the Learning Organization”* (Exhibit 2) based upon adaptation of Senge’s five disciplines as related to the firm’s leadership priorities.

The importance of a statement of purpose, direction, vision or mission is directly related to its contextual importance in guiding the organization. The firm must ask why do we exist and what is our direction (Drucker, 1994; Griffiths, 1996; Maciariello, 2000; Senge, 1990a)? This is a generative process that requires the discipline of shared vision. Appropriate systemic structures will be designed to cooperate and enable this overarching purpose. Here firms utilize the disciplines of systems thinking and mental models to develop the generative process of conceptualizing strategies in a climate of openness. During the assessment process, organizations will examine patterns of behavior and will react to events and operations. This reactive activity requires the disciplines of personal mastery and team learning. When an organization builds a firm foundation based upon a shared vision and systemic structures that harmonize with the vision, the learning organization will be enabled. Patterns of behavior and actions that support learning will find harmony with this foundation. However, this is not an automatic process. While behaviors and events will find harmony, a personal engagement with the vision must be continually articulated and filtered down through cultural norms, policies and procedures. Without attention to detail, the vision will become an empty promise, tacked on the wall or forgotten in a drawer.

While an organization's management can express these objectives in their mission, vision, purpose, objectives, values and norms, the veridicality of converting the explicit theories into theories-in-use can only be judged by studying the actual organizational structure and behaviors. The Jet Propulsion Laboratory as an R & D facility is committed to being a "knowledge creating company." It is hypothesized that the lab can improve creativity and learning by studying their processes in relationship to the theories considered here. We propose such a study.

We have discussed the fact that organizational learning has been considered an "umbrella" term that covers a variety of topics including; learning curves, productivity, organizational memory, organizational forgetting, knowledge transfer, knowledge sharing, knowledge assets, dynamic capabilities, knowledge management, and knowledge creation. However, this treatise has shown that the learning organization can be considered from a systems perspective as a strategy of the firm. The theory of organizational learning and the five disciplines proposed by Senge (1990) has been compared and contrasted with the theories of other organizational researchers and with the Jet Propulsion Laboratory's Implementation Plan. We have found major themes that derive from these models. These themes are hypothesized to translate into increased creativity and learning in organizations. Reviewed here are two new organizational models. The first traces the learning process as compared to the organizational learning literatures. The second is a model of Building the Learning Organization. It is suggested that a qualitative study of these models be tested at the Jet Propulsion Laboratory through a series of interviews with JPL employees, managers and executives.

It is my contention that in order to embrace learning, a systems perspective must be embraced. Senge discusses "**metanoia**", a shift of mind to grasp the deeper meaning of



"learning." Learning is more than taking in information. Unfortunately, many of our social institutions are designed more toward controlling than toward learning. In the words of Senge (1990) "Ironically, by focusing on performing for someone else's approval, corporations create the very conditions that predestine them to mediocre performance. Over the long run superior performance depends on superior learning."

## REFERENCES

- Abrahamson, E., & Rosenkopf, L. (1997). Social Network Effects on the Extent of Innovation Diffusion: A Computer Simulation. *Organization Science*, 8(No. 3 May-June), 289-309.
- Adler, P., S. (1988). Managing Flexible Automation. *California Management Review*(Spring 1988), 34-56.
- Adler, P. S., & Clark, K. B. (1991). Behind the learning curve: A sketch of the learning process. *Management Science*, 37, 267-281.
- Alavi, M., & Leidner, D. (1998). *Knowledge Management Systems: Emerging Views and Practices from the Field*. Paper presented at the Hawaii International Conference on Systems Science, Hawaii.
- Alavi, M., & Leidner, D. (1999). Knowledge Management Systems: Issues, Challenges, and Benefits. *Communications of the Association for Information Systems*, 1(February).
- Allen, T. J. (1977). *Managing the flow of technology: Technology transfer and the dissemination of technological information within the R & D organization*. Cambridge, MA: MIT Press.
- Anand, V., Manz, C. C., & Glick, W. H. (1998). An Organizational Memory Approach to Information Management. *Academy of Management Review*, 23(4), 796-809.
- Ansoff, H. L. (1975). Managing strategic surprise by response to weak signals. *California Management Review*, 18, 21-33.
- Argote, L. (1999). *Organizational learning: Creating, retaining, and transferring knowledge*. Norwell, MA: Kluwer.
- Argote, L., Beckman, S. L., & Epple, D. (1990). The persistence and transfer of learning in industrial settings. *Management Science*, 36, 140-154.
- Argote, L., & Darr, E. D. (in press). Repositories of knowledge in franchise organizations: Individual, structural and technological. In G. Dosi, R. Nelson, & S. Winter (Eds.), *Nature and dynamics of organizational capabilities*.
- Argote, L., & Ingram, P. (2000). Knowledge Transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes*, 82(1, May), 150-169.
- Argote, L., & McGrath, J. E. (1993). Group processes in organizations: Continuity and change. *International Review of Industrial and Organizational Psychology*, 8, 333-389.
- Argyris, C. (1983). Action Science and Intervention. *Journal of Applied Behavioral Science*, 19, 115-140.
- Argyris, C. (1985). *Strategy, Change, and Defensive Routines*. Boston: Pitman.
- Argyris, C., & Schon, D. A. (1978). *Organizational Learning: A Theory of Action Perspective*. Reading, MA: Addison-Wesley.
- Attewell. (1992). Technology diffusion and organizational learning: The case of business computing. *Organization Science*, 3(1), 1-19.
- Badaracco, J., Jr. (1991). *The Knowledge Link; How Firms Compete Through Strategic Alliances*. Boston, MA: Harvard University Press.
- Barnard, C., I. (1938). *The Functions of the Executive*. (30th Anniversary Edition ed.). Cambridge, MA: Harvard University Press.
- Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120.
- Bartlett, C., A., & Ghoshal, S. (1995). Changing the Top Role of Management; Beyond Systems to People. *Harvard Business Review*(May-June 1995).
- Bower, G. H., & Hilgard, E. R. (1981). *Theories of Learning*. Englewood Cliffs, N. J.: Prentice Hall.
- Bower, J., L., & Hout, T., M. (1988). Fast-Cycle Capability for Competitive Power. *Harvard Business Review*(November-December, 1988), 110-118.
- Brand, A. (1998). Knowledge management and innovation at 3M. *Journal of Knowledge Management*, 2(1), 17-22.
- Bresman, H., Birkinshaw, J., & Nobel, R. (1999). Knowledge Transfer In International Acquisitions. *Journal of International Business Studies*, 30(3), 439-462.
- Brown, J. S., & Duguid, P. (1998). Organizing Knowledge. *California Management Review*, 40(3), 90-111.
- Burt, R. S. (1992). *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.
- Cangelosi, V. E., & Dill, W. R. (1965). Organizational learning: Observations toward a theory. *Administrative Science Quarterly*, 10, 175-203.
- Clark, H. (1996). *Using Language*. Cambridge, England: Cambridge University Press.

- Clark, H., & Brennan, S. (1993). *Grounding in communication*. In *Groupware and computer-supported cooperative work*. San Francisco, California: Morgan Kaufmann.
- Coff, R. (1999, August, 1999). *Who reaps the gains from social capital? Appropriating Rent from Dynamic Capabilities*. Paper presented at the Academy of Management Meeting, Chicago.
- Culnan, M. J., & Markus, M. L. (1987). Information technologies. In F. Jablin, L. Putnam, K. Roberts, & L. Porter (Eds.), *Handbook of Organizational Communication*. Beverly Hills: Sage.
- Cyert, R., M., & March, J. G. (1963, 1992). *A Behavioral Theory of the Firm*. (2nd. ed.). Cambridge MA: Blackwell Publishers (1st Ed. , 1963, Englewood Cliffs, N.J., Prentice Hall).
- Daft, R., L., & Weick, K., E. (1984). Toward a Model of Organizations as Interpretation Systems. *Academy of Management Review*, 28, 57-91.
- Daft, R. L., & Huber, G. P. (1987). How organizations learn: A communication framework. *Research in the Sociology of Organizations*, 5(1-36).
- Daft, R. L., & Lengel, H. R. (1986). Organizational Information Requirements, Media Richness, and Structural Design. *Management Science*, 32, 554-571.
- Darr, E. D., & Kurtzberg, T. R. (2000). An investigation of partner similarity dimensions on knowledge transfer. *Organizational Behavior and Human Decision Processes*, 82(1, May), 28-44.
- Davenport, T. H., Jarvenpaa, S. L., & Beers, M. C. (1996). Improving Knowledge Work Processes. *Sloan management Review*, Summer, 53-65.
- Davenport, T. H., & Prusak, L. (1998). *Working Knowledge: How Organizations Manage What They Know*. Boston, MA: Harvard Business School Press.
- Day, G., S. (1994). The Capabilities of Market Driven Organizations. *Journal of Marketing*(October 1994).
- de Kluyver, C. (1999). *Strategic Thinking: An Executive Perspective*: Prentice Hall.
- Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation and Sustainability of Competitive Advantage. *Management Science*, 35, 1504-1511.
- Donnellon, A., Gray, B., & Bougon, M. G. (1986). Communication, meaning, and organized action. *Administrative Science Quarterly*, 31, 43-55.
- Driver, M. J., & Steufert, S. (1969). Integrative complexity: An approach to individuals and groups as information processing systems. *Administrative Science Quarterly*, 14, 272-285.
- Drucker, P., F. (1988). The Coming of the New Organization. *Harvard Business Review*(January-February, 1988).
- Drucker, P., F. (1991). The New Productivity Challenge. *Harvard Business Review*(November-december, 1991), 69-79.
- Drucker, P., F. (1994). The Theory of the Business. *Harvard Business Review*( September/October), 96-104.
- Drucker, P. F. (1979). Managing the Knowledge Worker. *Modern Office Procedures*, 24(9).
- Drucker, P. F. (1999). Knowledge-Worker Productivity: The Biggest Challenge. *California Management Review*, 41(2), 79-94.
- Duarte, D. L., & Snyder, N. T. (1999). *Mastering Virtual Teams Strategies, Tools, and Techniques that Succeed*. San Francisco: Jossey-Bass.
- Due, R., T. (1995). The Knowledge Economy. *Information Systems Management*(Summer 1995), 5-8.
- Duncan, R., & Weiss, A. (1979). Organizational learning: Implications for organizational design. *Research in Organizational Behavior*, 1, 75-123.
- Dvorak, R., Dean, D., & Singer, M. (1994). Accelerating IT Innovation (Delivering the Value From IT). *McKinsey Quarterly*(Autumn 1994), 123-136.
- Ebbinghaus, H. (1964, original published 1885). *Memory: A contribution to experimental psychology* (Ruger, H. A. Bussenius, C. E., Trans.). New York: Dover.
- Eisenhardt, K. M., & Tabrizi, B. N. (1995). Accelerating adaptive processes: Product innovation in the global computer industry. *Administrative Science Quarterly*, 40, 84-110.
- Ellsworth, R. R. (1999). *Creating Value through Diversification and Acquisitions* (Working paper ). Claremont, CA: Peter F. Drucker School, Claremont Graduate University.
- Feldman, J., & Kanter, H. E. (1965). Organizational decision making. In J. G. March (Ed.), *Handbook of Organizations* (pp. 614-649). Chicago: Rand McNally.
- Fiol, C. M., & Lyles, M. A. (1985). Organizational learning. *Academy of Management Review*, 10, 803-813.
- Foster, R. (1986). *Innovation: The Attacker's Advantage*. New York: Summit Books.
- Fuld, L. M. (1988). *Monitoring the Competition: Find Out What's Really Going on Over There*. Somerset, N. J.: John Wiley & Sons.
- Gersick, C., & Hackman, J. R. (1990). Habitual routines in task-performing groups. *Organizational Behavior and Human Decision Processes*, 47, 65-97.

- Ghoshal, S., & Bartlett, C. A. (1997). *The Individualized Corporation: A Fundamentally New Approach to Management*. (1 ed.). New York: HarperCollins.
- Gilbert, M., & Cordey-Hayes, M. (1996). Understanding the process of knowledge transfer to achieve successful technological innovation. *Technovation*, 16, 301-312.
- Granovetter, M. (1992). Problems of explanation in economic sociology. In N. Nohria & R. G. Eccles (Eds.), *Networks and Organizations* (pp. 25-56). Boston, MA: Harvard Business School Press.
- Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, 17, 109-122.
- Gray, P., & Jurison, J. (1995). *Productivity in the Office and the Factory*. Danvers, MA: Boyd & Fraser Publishing Co.
- Gregerman, I. B. (1981). Knowledge Worker Productivity Measurement Through the Nominal Group Technique. *Industrial Management*, 23(1).
- Griffiths, L., of Fforestfach. (1996, 1996). *The Business of Values*. Paper presented at the The Hansen-Wessner Lecture Series, The Peter F. Drucker Graduate Management Center of the Claremont Graduate School, Claremont, CA.
- Guetzkow, H., & Simon, H. A. (1955). The impact of certain communication nets upon organization and performance in task-oriented groups. *Management Science*, 1, 233-250.
- Halloran, J. P. (1993). Achieving World-Class End-User Computing: Making IT work and Using IT Effectively. *Information systems management*(Fall 1993), 7-12.
- Hansen, M. T., Nohria, N., & Tierney, T. (1999). What's Your Strategy for Managing Knowledge? *Harvard Business Review*(March-April), 106-116.
- Harris, S. G. (1994). Organizational culture and individual sensemaking. *Organization Science*, 5, 309-321.
- Hayek. (1945). The use of knowledge in society. *American Economic Review*, 35, 519-530.
- Hayek, F. A. (1989). The pretense of knowledge. *American Economic Review*, 79, 3-7.
- Hayes, R. H., & Clark, K. B. (1985). *Exploring productivity differences at the factory level*. New York: Wiley.
- Hayes, R. H., & Clark, K. B. (1986). Why some factories are more productive than others. *Harvard Business Review*, 64(5), 66-73.
- Hedberg, B. L. T. (1981). How organizations learn and unlearn. In P. C. Nystrom & W. H. Starbuck (Eds.), *Handbook of Organizational Design* (Vol. 1, ). New York: Oxford University Press.
- Hedberg, B. L. T., Nystrom, P. C., & Starbuck, W. H. (1976). Camping on seesaws: Prescriptions for a self-designing organization. *Administrative Science Quarterly*, 2, 39-52.
- Hedberg, B. L. T., Nystrom, P. C., & Starbuck, W. H. (1977). Designing organizations to match tomorrow. In P. C. Nystrom & W. H. Starbuck (Eds.), *Prescriptive Models of Organizations*. Amsterdam: North Holland.
- Hedlund, C. (1994). A model of knowledge management and the N-form corporation. *Strategic Management Journal*, 15, 73-90.
- Henderson, R. M., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal*, 15(Winter Special Issue), 63-84.
- Heskett, J. L., Sasser, E. W. J., & Schlesinger, L. A. (1997). *The Service Profit Chain: How leading companies link profit and growth to loyalty, satisfaction, and value*. New York, NY: The Free Press.
- Hilgard, E. R., & Bower, G. H. (1975). *Theories of learning*. (4th. ed.). Englewood Cliffs, N. J.: Prentice-Hall.
- Houston, J. P. (1986). *Fundamentals of learning and memory*. (3rd. ed.). New York: Harcourt Brace Jovanovich.
- Huber, G. P. (1982). Organizational information systems: Determinants of their performance and behavior. *Management Science*, 28, 135-155.
- Huber, G. P. (1991). Organizational Learning: The contributing processes and the literatures. *Organization Science*, 2, 88-115.
- Huber, G. P., & Daft, R. L. (1987). The information environments of Organizations. In F. Jablin, L. Putnam, K. Roberts, & L. Porter (Eds.), *Handbook of Organizational Communication*. Beverly Hills: Sage.
- Huber, G. P., Ullman, J., & Leifer, R. (1979). Optimum organization design: An analytic adoptive approach. *Academy of Management Review*, 4, 567-578.
- Iansiti, M., & West, J. (1997). Technology Integration: Turning Great Research into Great Products. *Harvard Business Review*, 75(No. 3, May-June), 69-79.
- Ingram, P., & Baum, J. A. C. (1997). Opportunity and Constraint: Organizations Learning from the Operating and Competitive Experience of Industries. *Strategic Management Journal*, 18(7), 75-98.
- Ireland, R. D., Hitt, M. A., Bettis, R. A., & DePorras, D. A. (1987). Strategy formulation processes: Differences in perceptions of strength and weaknesses indicators and environmental uncertainty by managerial level. *Strategic Management Journal*, 8, 469-485.
- Itami, H. (1987). *Mobilizing invisible assets*. Cambridge, MA: Harvard University Press.

- Jinag, j., J. (1995). Using Scanner Data; IS in the Consumer Goods Industry. , *Information Systems Management*(Winter 1995), 61-66.
- Jurison, J. (1995). Defining and Measuring Productivity, *Productivity in the Office and the Factory* (pp. 11-21). Danvers, MA: Boyd & Fraser.
- Kaplan, R. S., & Norton, D. P. (1996). *The Balanced Scorecard: Translating Strategy into Action*. Boston: Harvard Business School Press.
- Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3, 383-397.
- Krackhardt, D., & Hanson, J. R. (1993). Informal networks: The company behind the chart. *Harvard Business Review*, 71(4), 104-111.
- Kuwada, K. (1998). Strategic Learning: The Continuous Side of Discontinuous Strategic Change. *Organization Science*, 9(6, November-December), 719-736.
- Leavitt, H. J. (1967). Some effects of certain communication patterns on group performance. *Journal of Abnormal and Social Psychology*, 46, 38-50.
- Lenehan, M. (1982, August). The quality of the instrument. *The Atlantic Monthly*, 250(2), 32-58.
- Leonard-Barton, D. (1990). Modes of technology transfer within organizations: Point-to-point versus diffusion, *Working Paper 90-060* : Harvard Business School.
- Lester, R. K., & McCabe, M. J. (1993). The effect of industrial structure on learning by doing in nuclear power plant operation. *The Rand Journal of Economics*, 24, 418-438.
- Levitt, B., & March, J. G. (1988). Organizational Learning. *Annual Review of Sociology*, 14, 319-340.
- Lewin. (1947). Group Decision and Social Change. In T. N. Newcomb & E. L. Hartley (Eds.), *Readings in Social Psychology*. Troy, MO: Holt, Rinehart & Winston.
- Lewin, K. (1951). *Field Theory in Social Science*. New York: Harper & Rowe.
- Lieberman, M. B. (1984). The learning curve and pricing in the chemical processing industries. *The Rand Journal of Economics*, 15, 213-228.
- Lipman-Blumen, J., & Leavitt, H. J. (1999). Hot Groups "With Attitude": A New Organizational State of Mind. *Organizational Dynamics*, 27(4), 63-73.
- Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *The Rand Journal of Economics*, 13, 418-438.
- Lounamaa, P. H., & March, J. G. (1987). Adaptive coordination of a learning team. *Management Science*, 33(107-123).
- Lyles, M. A. (1988). Learning among joint -venture sophisticated firms. *Management International Review*, 28, 85-98.
- Maciariello, J. A. (1997). Management Systems at Lincoln Electric: A Century of Agility. *Journal of Agility & Global Competition*(Winter), 46-61.
- Maciariello, J. A. (2000). *Lasting Value: A Century of Agility at Lincoln Electric*. New York: John Wiley & Sons.
- Majchrzak, A., Neece, O. E., & Cooper, L. P. (2000a). *Knowledge Reuse for Innovation - The Missing Focus in Knowledge Management: Results of a case analysis at the Jet Propulsion Laboratory*. Unpublished Working Paper, University of Southern California, Los Angeles, CA.
- Majchrzak, A., Rice, R. E., Malhotra, A., King, N., & Ba, S. (2000b). Computer-mediated inter organizational knowledge-sharing: Insights from a virtual team innovating using a collaborative tool. *Information Resources Management Journal*, 13(1), 44-59.
- March, J. G., & Olsen, J. P. (1979). *Ambiguity and Choice in Organizations*. (2nd ed.). Bergen: Universitetsforlaget.
- Markus, M. L. (2000). The Varieties of Knowledge Reuse--Key Management Issues and Challenges. (*in progress*).
- Markus, M. L., Majchrzak, A., & Gasser, L. (2000). *A Design Theory for Systems That Support Emergent Knowledge Processes*. Paper presented at the ??
- Marshall, E. (1989, June 6). Losing our memory. *Science*, 244, 1250.
- Matusik, S. F., & Hill, C. W. L. (1998). The Utilization of Contingent Work, Knowledge Creation, and Competitive Advantage. *Academy of Management Review*, 23(4), 680-697.
- McKinsey. (1998). Best practice and beyond: Knowledge strategies. *McKinsey Quarterly*, 1.
- Meier, R. L. (1963). Communications overload: Proposals from the study of a university library. *Administrative Science Quarterly*, 4(521-544).
- Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, 83, 440-463.
- Michael, D. N. (1973). *On Learning to Plan---and Planning to Learn*. San Francisco: Jossey-Bass.

- Miller, D. B. (1977). How to improve the performance and productivity of the knowledge worker. *Organizational Dynamics*, 5(3).
- Mintzberg, H. (1975). The Manager's Job: Folklore and Fact. *Harvard Business Review*(July-August), 49-61.
- Moorman, C., & Miner, A. S. (1998). Organizational Improvisation and Organizational Memory. *Academy of Management Review*, 23(4), 698-723.
- Neece, O. E. (2000). *A systems perspective of virtual team structure and process: A case study at Nortel Networks*. Unpublished Working Paper, Claremont Graduate University, Claremont, CA.
- Nelson, R., & Winter, S. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.
- Nelson, R. R. (1991). Why Do Firms Differ and What Does It Matter? *Journal of Strategic Management*, 12, 61-74.
- Nobles, W., & Redpath, J. (1997). Market Based Management<sup>TM</sup>: A Key to Nucor's Success. *Journal of Applied Corporate Finance*, 10(3), 105-106.
- Nonaka, I. (1991). The Knowledge-Creating Company. *Harvard Business Review*(November-December).
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14-37.
- Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company*. New York: Oxford University Press.
- Olivera, F., & Argote, L. (2000). Organizational learning and new product development: CORE processes. In L. Thompson, D. M. Messick, & J. M. Levine (Eds.), *Shared Knowledge in Organizations*. Mahwah, N. J.: Lawrence Erlbaum.
- Olson, G. M., & Olson, J. S. (1998). Making sense of the findings: Common vocabulary leads to the synthesis necessary for theory building. In K. Finn, A. Sellen, & S. Wilbur (Eds.), *Video-mediated Communication*. Hillsdale: Erlbaum.
- Ouchi, W. G. (1980). Markets, bureaucracies, and clans. *Administrative Science Quarterly*, 25, 129-141.
- Pfeffer, J. (1994). *Competitive Advantage Through People; Unleashing the Power of the Work Force*. Boston: Harvard Business School Press.
- Pisano, G. P. (1994). Knowledge, integration, and the locus of learning: An empirical analysis of process development. *Strategic Management Journal*, 15, 85-100.
- Polanyi, M. (1966). *The Tacit Dimension*. London: Rutledge & Kegan Paul.
- Porter, M. E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: The Free Press.
- Porter, M. E. (1996). What Is Strategy? *Harvard Business Review*(November - December), 61-78.
- Prahalad, C. K. a. G. H. (1990). The Core Competence of the Corporation. *Harvard Business Review*, 90 No 3(May - June), 79 - 91.
- Prokesch, S. E. (1997). Unleashing the Power of Learning: An Interview with British Petroleum's John Browne. *Harvard Business Review*, September-October.
- Rapping, L. (1965). Learning and World War II production functions. *Review of Economics and Statistics*, 47, 81-86.
- Reed, R., & deFillippi, R. J. (1990). Causal ambiguity, barriers to imitation, and sustainable competitive advantage. *Academy of Management Review*, 15, 88-102.
- Rogers, E. (1983). *The diffusion of innovation* (3rd. ed.). New York: Free Press.
- Sanchez, R., & Mahoney, J. T. (1996). Modularity, flexibility, and knowledge management in product and organization design. .
- Schein, E. H. (1985). *Organizational Culture and Leadership*. (Second ed.). San Francisco: Jossey-Bass.
- Senge, P. (1990a). *The Fifth Discipline: The Art & Practice of the Learning Organization*. New York: Currency Doubleday.
- Senge, P. M. (1990b). The Leader's New Work: Building Learning Organizations. *Sloan Management Review*, 32(Fall, No. 1), 7-23.
- Sherman, W. S., & Lacey, M. Y. (1999, August 9, 1999). *The Role of Tacit Knowledge in the Team Building Process: Explanations and Interventions*. Paper presented at the Academy of Management Meeting, Chicago.
- Short, J., Williams, E., & Christie, B. (1976). *The Social Psychology of Telecommunications*. New York: John Wiley.
- Simon, H. A. (1957). *Administrative Behavior*. (2nd ed.). New York: The Macmillan Company.
- Simon, H. A. (1973). Applying information technology to organization design. *Public Administration Review*, 33, 268-278.
- Sitkin. (1992). Learning through failure: The strategy of small losses. In B. M. Staw & L. L. Cummings (Eds.), *Research in Organizational Behavior* (Vol. 14, ). Greenwich, CT: JAI Press.
- Spender. (1989). *Industry Recipes*. Oxford: Blackwell.

- Spender, J. C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, 17(Winter Special Issue), 45-62.
- Starbuck, W. H. (1984). Organizations as action generators. *American Sociological Review*, 48, 91-102.
- Starbuck, W. H., & Milliken, F. J. (1988). Executives perceptual filters: What they notice and how they make sense. In D. Hambrick (Ed.), *The Executive Effect: Concepts, and Methods for Studying Top Managers* (pp. 35-66). Greenwich, CT: JAI Press.
- Staw, B. M. (1977). The Experimenting Organization: Problems and Prospects, *Psychological Foundations of Organization Behavior*. Psadesacific Palisades, CA: Goodyear.
- Staw, B. M., & Ross, J. (1987). Behavior in escalations situations: Antecedents, prototypes, and solutions. In L. L. Cummings & B. M. Staw (Eds.), *Research in Organizational Behavior* (Vol. 9, pp. 39-78).
- Stinchcombe, A. L. (1965). Social structure and organizations. In J. G. March (Ed.), *Handbook of Organizations*. Chicago: Rand McNally.
- Stone, E. C., & Dumas, L. N. (2000). *The JPL Implementation Plan: Implementing NASA's Mission at the Jet Propulsion Laboratory*. Pasadena, CA: The Jet Propulsion Laboratory.
- Strebel, P. (1994). Choosing the right change path. *California Management Review*, 36(Winter), 30
- Szulanski, G. (1994). *Intra-firm transfer of best practices project: Executive summary of the findings (Report)*: APQC.
- Szulanski, G. (2000). The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness. *Organizational Behavior and Human Decision Processes*, 82(1, May), 9-27.
- Taylor, F. (1911). *The Principles of Scientific Management*. New York, Harper.
- Teece, D. (1990). Contributions and impediments of economic analysis to the study of strategic management. In J. Fredrickson (Ed.), *Perspectives on Strategic Management* (pp. 39-80). New York: Harper Business.
- Teece, D. J. (1981). The market for know-how and the efficient transfer of technology. *The Annals of the American Academy of Political and Social Science*, 458, 81-96.
- Teece, D. J. (1984). Economic Analysis and Strategic Management. *California Management Review*, 26(3), 87-110.
- Teece, D. J. (1998). Capturing value from knowledge assets: The new economy markets for know-how and intangible assets. *California Management Review*, 40(3), 55-79.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18(7), 509-533.
- Telleen, S. (1999). *Frequently Asked Questions*, [internet]. i-net organization and management,. Available: <http://www.iorg.com/questions.html> [1999, July 21].
- Thompson, K. R., Hochwarter, W. A., & Mathys, N. J. (1997). Stretch targets: What makes them effective? *Academy of Management Executive*, 11(3), 48-60.
- Thorndike, E. L. (1898). Animal Intelligence: An experimental study of the associative processes in animals. *The Psychological Review: Series of Monograph Supplements*, 2, 1-109.
- Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal*, 17(Winter), 11-25.
- Tuomi, I. (1999). Data is More Than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory. *Journal of Management Information Systems*, 16(3, Winter), 103-117.
- Tversky, A., & Kahneman, D. (1985). The framing of decisions and the psychology of choice. In G. Wright (Ed.), *Behavioral Decision Making*. New York: Plenum Press.
- von Hippel, E. (1994). "Sticky Information" and the locus of problem solving: Implications for innovation. *Management Science*, 40(4), 429-439.
- von Hippel, E., & Tyre, M. J. (1995). How learning by doing is done: Problem identification in novel process equipment. *Research Policy*, 24, 1-12.
- Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling Knowledge Creation: How to unlock the mystery of tacit knowledge and release the power of innovation*. New York: Oxford University Press.
- Walker, G. (1985). Network position and cognition in a computer software firm. *Administrative Science Quarterly*, 30, 103-130.
- Walsh, J., P., & Ungson, G., R. (1991). Organizational Memory. *Academy of Management Review*, 16, 57-91.
- Weick, K. E. (1979). Cognitive processes in organizations. *Research in Organizational Behavior*, 1, 41-74.
- Weston, D. M. (1993). *Organization Learning as Strategy*. Menlo Park, CA: SRI International, Business Intelligence Program.
- Wildavsky, A. (1972). The Self-Evaluating Organization. *Public Administration Review*, 32 N 5(Sep-Oct 1972), 502-509.

- Wingfield, A. (1979). *Human Learning and Memory: An Introduction*. New York: Harper & Rowe.
- Winter, S. G. (1987). Knowledge and Competence as Strategic Assets. In D. Teece (Ed.), *The Competitive Challenge* (pp. 159-184). New York: Harper and Row.
- Winter, S. G. (1995). Four Rs of profitability: Rents, resources, routines and replication. In C. A. Montgomery (Ed.), *Resource based and evolutionary theories of the firm: Towards a synthesis*. Norwell, MA: Kluwer.
- Zaltman, G., Duncan, R., & Holbek, J. (1973). *Innovations and organizations*. New York: Wiley.
- Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and limitation of organizational capabilities: An empirical test. *Organization Science*, 6, 76-92.